NEWSLINE
THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

EDITOR'S NOTE

After 4 July 2012, 8 October 2013 was another important date in the life of particle physicists when the work of François Englert and Peter Higgs was recognised with the 2013 Physics Nobel Prize. At the same moment, the thousands of LHC particle physicists felt also rewarded for their hard work in finding the Higgs particle. Much more than just another member in the particle zoo, the Higgs boson discovery has opened the door to a whole new range of questions, which the LHC and the linear collider will try to solve. Find out more in this issue about how a linear collider can help in study of the Higgs particle and read again our special "Higgs discovery issue" of 5 July 2012.

FEATURE

From CERN: CERN congratulates François Englert and Peter W. Higgs on the award of the 2013 Nobel Prize in Physics

CERN congratulates François Englert and Peter W. Higgs on the award of the Nobel prize in physics "for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider." The announcement by the ATLAS and CMS experiments took place on 4 July last year.

DIRECTOR'S CORNER

Yes!

by Hitoshi Murayama

The Nobel Prize in Physics this year has gone to François Englert and Peter Higgs for their theoretical discovery of the Higgs mechanism, recently confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's LHC. The linear collider community, represented by Deputy LCC Director Hitoshi Murayama, congratulates the two theorists on this appropriate award for the monumental work.

AROUND THE WORLD

ILC moves forward in Japan

by Hitoshi Murayama and Satoru Yamashita

Many of you have seen a media report titled "Science council seeks more study of Japan's role in particle collider". You may have wondered what this means for the ILC. Hitoshi Murayama and Satoru Yamashita explain that it's much better than it sounds.

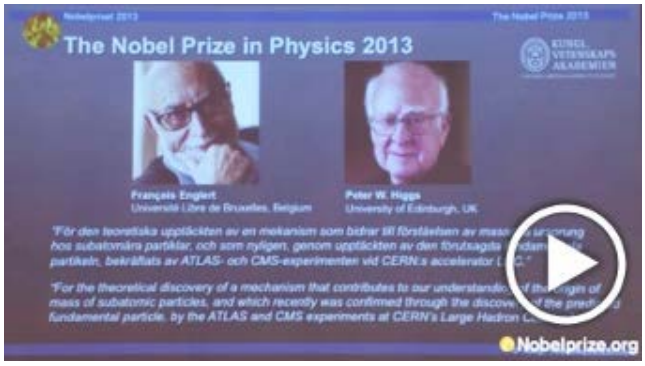
IMAGE OF THE WEEK

Stairway study

by Barbara Warmbein

After publishing the physics and detector chapters for the CLIC Conceptual Design Report organised only through working groups on various different study topics and detector R&D projects, the CLIC physics and detector community has spent the last months putting a new organisation in place: the CLIC detector and physics study. So far, 19 institutes have joined the study that is hosted at CERN. Frank Simon, MPI Munich, was elected as the chair of the Institute Board and Lucie Linssen as the first spokesperson. At their meeting at CERN last week, some 50 representatives from the various institutes met at CERN to discuss progress on physics simulations and detector development.

VIDEO OF THE WEEK



2013 Nobel Prize in Physics announcement

The Nobel Prize in Physics 2013 was awarded jointly to François Englert and Peter W. Higgs "for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider"

IN THE NEWS

from ***Bloomberg***
9 October 2013
Cash-Challenged CERN Lifted by Nobel Win in Hunt for BRIC Funds
Still, the rest of the world isn't sitting still. Japan is considering a $7.8 billion linear collider project of its own. CERN is open to helping to set up the facility and cooperating on research, Heuer said.

from ***Kahoku Shinpo***
9 October 2013
東北の　　誘致に弾み ヒッグス教授らノーベル物理学賞

指

今年のノーベル物理学賞に、ピーター・ヒッグス名誉教授らが決まった　日、「国際リニアコライダー　　」の誘致を目　す宮城、岩手両県など東北の関係者からは「　　の誘致実現に弾みがつく」と期待の声が上がった。(On the news of the Npbel prize in physics was awarded for Dr. Higgs, local officials in Iwate and Miyagi prefecture said that it will boost the activities to invite the ILC to Tohoku area.)

from ***The Deccan Chronicle***
8 October 2013
Higgs, the man who saw the 'God Particle', gets Nobel
Peter Higgs, he said, loves the idea of the International Linear Collider. "The ILC is the biggest thing to happen to particle physics since the Large Hadron Collider. Although we're sure that the LHC has found a Higgs Boson, we still aren't sure if it is the actual one.

from ***The Deccan Chronicle***
8 October 2013
Higgs done, IISc Prof looks beyond
India's role in this will be to expertise on crucial technology – the superconducting radiofrequency cavities, within which the particles are accelerated and made to collide. (…) The world community has chosen this as the technology for the ILC, thereby propelling India's role through her expertise. Japan's scientific community has expressed a strong interest in hosting the ILC on the outskirts of Tokyo and is awaiting approval from its government.

from ***NHK***
8 October 2013
ノーベル物理学賞にヒッグス氏ら
ヒッグス氏らのノーベル物理学賞の受賞が決まったことについて、東北大学大学院の山本均教授は「今回のノーベル賞の受賞で　の役割が注目され、高い技術を持つ日本への誘致に大きな弾みになる」と述べ、誘致の取り組みが進むことに期待を寄せました。(On the new of the Nobel prize in physics went to Dr. Higgs, Hitoshi Yamamoto of Tohoku University, said "This news will draw attention to the ILC, and will boost the activity to invite it to Japan."

from ***Panorama.it***
8 October 2013
"Il bosone di Higgs è un nuovo amico. Ora dobbiamo conoscerlo meglio"
"Una possibilità che si sta discutendo è quella di costruire in Giappone la prossima grande macchina destinata ad accelerare le particelle, il cosiddetto Linear Collider. Insomma, si va sempre più nella direzione di dar vita a laboratori che ospitino esperimenti con la partecipazione di scienziati da tutto il pianeta." (One option that is being discussed is to build the next big machine aimed to accelerate particles in Japan, the so-called Linear Collider. In short, we're getting more and more on the path to giving life to laboratories that host experiments with the participation of scientists from all over the planet.)

from ***{Science²} (Blog de Libération)***
8 October 2013
Le Prix Nobel de Physique pour le boson Brout, Englert et Higgs
"(…) Michel Spiro [explique les] possibilités qui «sont discutées par la communauté. La première permettrait d'aller plus vite mais serait restreinte à un maximum de 500 GeV (milliards d'électronvolts): c'est une technologie appelée ILC (Collisionneur linéaire international), un accélérateur linéaire électron-positon basé sur des cavités supraconductrices comme celle qu'utilisent les Allemands à Hambourg pour faire du rayonnement synchrotron." (Michel Spiro [explains the future] opportunities which "are discussed by the community. The first would go faster but would be restricted to a maximum of 500 GeV (billion electron volts). It is a technology called ILC (International Linear Collider), a electron-positron linear accelerator based on superconducting cavities like the one used by the Germans in Hamburg for synchrotron radiation."

from ***Futura Sciences***
4 October 2013
Un accélérateur de particules qui tient sur le bout du doigt
On parle beaucoup ces derniers temps d'un autre accélérateur linéaire, mais qui reste pour le moment à l'état de projet, bien que les travaux nécessaires à sa conception soient arrivés à terme. Il s'agit de l'International Linear Collider (ILC). Il s'agit en fait d'un collisionneur formé de deux accélérateurs linéaires. Long de presque 31 km, il devrait produire des collisions d'électrons et de positrons à des énergies d'au moins 500 GeV. Les chercheurs aimeraient bien pouvoir réduire drastiquement les coûts et les tailles des machines qui lui succéderont.

from ***Science World Report***
3 October 2013
Next-gen Particle Accelerator "Not Built" at CERN but Japan

The successor to the Large Hadron Collider (LHC) – the world's most powerful particle accelerator – will most likely be based in Japan. But this does not mean the end of CERN, the European Organization for Nuclear Research, near Geneva.

from *The Japan News*
2 October 2013
Science council seeks more study of Japan's role in particle collider
The Science Council of Japan called on the Education, Culture, Sports, Science and Technology Ministry to spend two or three years studying whether the nation should take the initiative on an international project to build a next-generation particle accelerator.

from *Kahoku Shinpo*
2 October 2013
実現へ課題検討、有識者組織設置 文科相が方針
文部科学省は　日、「国際リニアコライダー　　」計画を検討する省内タスクフォースに、外部有識者による作業部会を設置することを明らかにした。省内の体制を強化して、　　計画の実現に向けた課題を検討する。下村博文文科相が同日の定例記者会見で示した。(Minister of Ministry of Education, Culture, Sports, Science and Technology, Hakubun Shimomura said in the general press conference that the government will create a working group of advisors with specialists from various fields to review the possible issues on the realisation of the ILC in Japan)

from *Nikkei*
30 September 2013
次世代加速器誘致の是非、　　年かけ検討を 日本学術会議
日本学術会議は30日、「国際リニアコライダー　　」の日本誘致について「是非を判断するために、　　年かけて集中的な調査検討が必要だ」とする提言を文部科学省に提出した。(Science Council of Japan submitted the report to the Ministry of Education, Culture, Sports, Science and Technology, that the government should take two to three years for an extended review for Japan to make a decision)

from *Scientific American (blog)*
30 September 2013
When the Large Hadron Collider Is Too Small
Right now, the leading proposal for a post-LHC project is the International Linear Collider, a pair of 11-kilometer-long electron guns pointing at each other as if in a subatomic duel. Earlier this year, planners staked out a site in the north of Japan. The Japanese government views the project as a post-tsunami economic stimulus for the region.

CALENDAR

Upcoming events

Linear Collider Forum 2013
DESY, Hamburg, Germany
09- 11 October 2013

SiD Workshop
SLAC, USA
14- 16 October 2013

LCWS 2013
The University of Tokyo, Japan
11- 15 November 2013

View complete calendar

PREPRINTS

ARXIV PREPRINTS

1310.0563
Study of top quark pair production near threshold at the ILC

1310.0261
Observations and predictions at CesrTA, and outlook for ILC

1309.7868

ANNOUNCEMENTS

Register now for LCWS 2013. Early registration closing soon!

The 2013 International Workshop on Future Linear Colliders (LCWS13) will be held at the Hongo Campus of the University of Tokyo, Japan (the main campus of the university close to central Tokyo), from 11 to 15 November.
The workshop will be devoted to the study of the physics case for a high-energy linear electron-positron collider, taking into account the recent results from the LHC, and to review the progress in the detector and accelerator designs for both ILC and CLIC projects.
For more information and registration, please visit the workshop webpage. The deadline for early registration is 15 October.

DPHEP: From Study Group to Collaboration

1309.7444
Pair Production of New Heavy Leptons with $U(1)'$ Charge at Linear Colliders

1309.7398
Computational accelerator science needs towards laser-plasma accelerators for future colliders

1309.7342
Electroweakino Searches: A Comparative Study for LHC and ILC (A Snowmass White Paper)

1309.7038
Strong Higgs Interactions at a Linear Collider

1309.5966
Electroweakinos in the Light of the Higgs Boson

CERN congratulates Englert and Higgs on Nobel in physics

François Englert (left) and Peter Higgs at CERN on 4 July 2012, on the occasion of the announcement of the discovery of a Higgs boson by the ATLAS and CMS experiments (Image: Maximilien Brice/CERN)

CERN congratulates François Englert and Peter W. Higgs on the award of the Nobel prize in physics "for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider." The announcement by the ATLAS and CMS experiments took place on 4 July last year.

"I'm thrilled that this year's Nobel prize has gone to particle physics," says CERN Director-General Rolf Heuer. "The discovery of the Higgs boson at CERN last year, which validates the Brout-Englert-Higgs mechanism, marks the culmination of decades of intellectual effort by many people around the world."

Members of the ATLAS and CMS collaborations react with jubilation at CERN as the announcement is made (Image: Maximilien Brice/CERN)

The Brout-Englert-Higgs (BEH) mechanism was first proposed in 1964 in two papers published independently, the first by Belgian physicists Robert Brout and François Englert, and the second by British physicist Peter Higgs. It explains how the force responsible for beta decay is much weaker than electromagnetism, but is better known as the mechanism that endows fundamental particles with mass. A third paper, published by Americans Gerald Guralnik and Carl Hagen with their British colleague Tom Kibble further contributed to the development of the new idea, which now forms an essential part of the Standard Model of particle physics. As was pointed out by Higgs, a key prediction of the idea is the existence of a massive boson of a new type, which was discovered by the ATLAS and CMS experiments at CERN in 2012.

The Standard Model describes the fundamental particles from which we, and all the visible matter in the universe, are made, along with the interactions that govern their behaviour. It is a remarkably successful theory that has been thoroughly tested by experiment over many years. Until last year, the BEH mechanism was the last

remaining piece of the model to be experimentally verified. Now that it has been found, experiments at CERN are eagerly looking for physics beyond the Standard Model.

The Higgs particle was discovered by the ATLAS and CMS collaborations, each of which involves over 3000 people from all around the world. They have constructed sophisticated instruments – particle detectors – to study proton collisions at CERN's Large Hadron Collider (LHC), itself a highly complex instrument involving many people and institutes in its construction.

CERN will be holding a press conference at 2pm CET today in the Globe of Science and Innovation. For those unable to attend, it will be webcast. Media questions can be submitted by Twitter using the hashtag #BosonNobel.

NEWSLINE
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DIRECTOR'S CORNER

Yes!

Hitoshi Murayama | 10 October 2013

I got up at 2am in the morning to watch the announcement of 2013 Nobel Prize in Physics. During an unexpected delay by one hour, thoughts started to wander whether the recipients might also be totally unexpected. But it was worth the wait. The announcement confirmed what we've been waiting for: recognition of François Englert and Peter Higgs for their monumental pieces of work.

François Englert (left) and Peter Higgs at CERN on 4 July 2012, on the occasion of the announcement of the discovery of a Higgs boson by the ATLAS and CMS experiments (Image: Maximilien Brice/CERN)

Why do some forces reach all the way from the Sun to the Earth, while some others work only inside the atomic nuclei? This seemingly very simple question was facing a seemingly insurmountable obstacle. The basic law of forces called gauge theory predicts that forces must be long-ranged. But if this were the case, the Sun would have burnt up too quickly for life to form on the Earth. There were even *theorems* that did not allow for short-ranged forces. Something had to give. A crazy idea was in order: something is frozen in the *empty space* of our Universe.

Englert, together with the late Robert Brout, showed that if a symmetry that underlies the gauge theory is *broken*, the force becomes short-ranged. If this is the case, Peter Higgs showed that there must be an unusual particle yet to be discovered. It must be frozen in our Universe.

On 4 July 2012, a candidate for this particle was announced by the ATLAS and CMS experiments runnning at the LHC. (see NewsLine special issue) A few months later, the new particle showed all signs to qualify for this job. We all thought a Nobel Prize was imminent. And there it is!

The original theoretical papers by Englert-Brout and Higgs, followed by half a century of painstaking effort by experimentalists to prove the theory, demonstrates incredible interplay between the actual phenomena we can observe in experiments and highly abstract mathematical theories. To understand the basic phenomenon of the burning Sun, we needed a short-ranged force, that was elevated to this crazy idea. It in turn predicted an elusive new particle that took thirty years of planning, fifteen years of building, and thousands of people to discover. What an amazing story.

Their theory and the experimental discovery mark a closure of a century-long story: we've been trying to understand the basic structure of matter we see around us. Since the discovery of the first elementary particle, the electron, back in 1897, we've come a long way. We can now finally explain how atoms, which make up *all* visible matter around us, can exist. Without the Higgs boson frozen in the Universe, our body would vaporize in a nanosecond.

At the same time, the discovery marks the opening of a new chapter. Only in the last fifteen years, we have learned that our century-long work is far from over. *We can only explain 5% of the Universe.* Without dark matter, which makes up about 25%, no stars and galaxies would have been born. On the other hand, dark energy, 70% of the Universe, is ripping the Universe apart. The Universe

started with the *Big Bang*, that must have made an equal amount of matter and anti-matter; but why don't we see anti-matter around us? It may well be thanks to neutrinos, which may turn into anti-neutrinos and back, reshuffling matter and anti-matter. Finally, why is the Universe so big, yet so smooth?

Many of us believe that the new particle holds a key to these mysteries. It is a bizarre particle: it is *faceless*. All elementary particles we have seen so far spin, like an eternal top. They look different if you look at them from another direction; they have faces. But the Higgs boson doesn't; it looks the same no matter how you look at it. It is very difficult to believe that there is just one faceless particle in nature that does the most important job. Therefore it is most likely the first one we've met in the faceless tribe. It probably has siblings (more Higgs bosons) and relatives (more faceless particles like in supersymmetry). And theoretically, a faceless particle is the best portal to other mysterious particles and forces. We have to study it very very careful to find clues. Remember the precision study of the orbit of Uranus told us that there must be its sibling, Neptune. We need a tool for the precision study of the Higgs boson.

The International Linear Collider (ILC), that smashes elementary particles instead of composite protons as in the LHC, will be a superb tool for this job. Curiously, the whole idea of Englert-Brout-Higgs mechanism was inspired by earlier papers by Yoichiro Nambu, 2008 Nobel Laureate in Physics, who got the idea from superconductivity in the laboratory. And it is this superconductivity that will make the ILC a reality. A circle of life.

Lastly, I truly believe that another Nobel Prize is in order for the ATLAS and CMS experiments. They proved that people around the world could work together to accomplish a common goal, even if they come from countries in political conflict. This is possible because fundamental science like ours is not a pursuit of personal or national interest. It is a true symbol of peace, an activity shared by the whole human race. Attention, Nobel Committee! Ahem, they deserve a *Nobel Peace Prize*.

ATLAS | CERN | CMS | ENGLERT | HIGGS | LHC | NOBEL PRIZE

NEWSLINE
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AROUND THE WORLD

ILC moves forward in Japan

Hitoshi Murayama and Satoru Yamashita | 10 October 2013

On 30 September, the Science Council of Japan (SCJ) submitted the report on the study of the International Linear Collider to the Ministry for Education, Culture, Sports, Science and Technology (MEXT). This was a response to the request by MEXT in May to the council to examine the ILC project including its scientific significance, the project's position in particle physics and in the whole of science, the significance of the project being hosted in Japan and the possible challenges the project will face.

Artist's view from the inside of the ILC tunnel. image: Rey. Hori

SCJ pointed out obvious issues with international projects, such as cost sharing, its governance model, and availability of leadership and personnel. Therefore, the report recommends the government to allocate the funds necessary to study risks and discuss with potential partners in the next two to three years. This is exactly what the chair of Linear Collider Board, Sachio Komamiya expected (see, *e.g.*, presentation at EPS2013).

In the report, the council recommends the creation of a budget to make an extensive review on the ILC project The government quickly followed up. MEXT has requested about 50 million yen (about half a million US dollars) to study the ILC project as a line item in the fiscal 2014 budget. Even though the amount is small, it is symbolic that the Japanese government for the first time allocates a "preparatory budget" for ILC as an official project. Namely, ILC is moving *forward* in Japan as a result of the SCJ report.

The report also recommended that a council of advisers to study the ILC further should be established. On 2 October, Minister of MEXT, Hakubun Shimomura said in the general press conference that the government will create a working group of advisors with specialists from various fields as soon as possible. A task force exclusively set up to study the ILC at MEXT has been working since February, deepening the understanding of the project in the ministry. A new working group will be set up under the task force, which will review the possible issues on the realisation of the ILC in Japan.

The reason why the MEXT asked SCJ to write this report was the development of the ILC project. MEXT and the Japanese government so far have not officially stated their interest to host the ILC as a global project. However, the ministry saw that the technical design of the ILC was completed in June this year by the international collaboration, and that the preparations for the project in the Japanese high-energy physics community and activities by politics, industries, and local government who promote this facility are very active. Also, the anticipation from foreign countries for Japan to take initiative of the project is rising. Because of these factors, the ministry recognises the need to examine the ILC project.

The council concluded that the ILC project has profound scientific significance. Given the discovery of a Higgs boson at LHC, the scientific significance of a next generation linear collider for its precision study is very clear. SCJ recognised that the most technically advanced linear collider design at this moment is the ILC, and they also recognised that the technical design report for the ILC, published last June, was the fruit of the detailed and careful effort by the international team. In addition, SCJ recognised the significance of the physics cases of the ILC, such as the precise measurement of the Higgs boson or top quark, and the investigation for new

physics beyond the Standard Model as a consequence. In addition, SCJ requested a clear explanation of the strategy for the search for new particles and new physics scenarios, taking into account the upgraded LHC programme, to justify the investment required for the project.

SCJ examined the possible issues and challenges if Japan should take the initiative on the ILC project. The council thinks that the ILC should be a project implemented by the international community with the scale and the cost required, and the rigid commitment from the prospective participating countries. The report stated that there were still some uncertainties in how the construction costs for the ILC should be shared among participating countries, the prospects for the participation of foreign scientists and the readiness of the implementation structure in Japan.

As the nation has been facing many issues, such as recovery from the earthquake, energy, natural resources and the environment, the ministry must prevent a situation in which spending on the ILC would adversely affect other priority items. The concern presented in this regard was how to balance the ILC and other national science projects. The report stated that it is not desirable for the country's academic development if the expenditure for the ILC would adversely effect other projects' progress, or eventually result in a reduction of research activity in general. To prevent such unfortunate situations, the council asked politics-government-academia to find imaginative ways to establish a system that will be supported by the citizens. Therefore, the council recommended a period of several years would be required for an extended review to allow Japan to make a decision.

Some media anticipated that the Japanese government would announce its intention to build the ILC, and viewed the SCJ report as a disappointment and a set back. This was never realistic. The best possible outcome at this stage is to get the government to take a more proactive role in assessing benefits and risks, and to engage in international discussions. The SCJ report indeed does recommend that the Japanese government should do so.

Tuesday's announcement of the Nobel prize in physics, which went to François Englert and Peter Higgs "*for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider*" will definitely boost the momentum of ILC activities in Japan. The ILC will study the particle they had proposed fifty years ago precisely so that we can understand its true nature and its connection to other big mysteries of the Universe.

JAPAN | MEXT | SCIENCE COUNCIL OF JAPAN

LC NEWSLINE
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IMAGE OF THE WEEK

Stairway study

Barbara Warmbein | 10 October 2013

After publishing the physics and detector chapters for the CLIC Conceptual Design Report organised only through working groups on various different study topics and detector R&D projects, the CLIC physics and detector community has spent the last months putting a new organisation in place: the CLIC detector and physics study. So far, 19 institutes have joined the study that is hosted at CERN. Frank Simon, MPI Munich, was elected as the chair of the Institute Board and Lucie Linssen as the first spokesperson. At their meeting at CERN last week, some 50 representatives from the various institutes met at CERN to discuss progress on physics simulations and detector development.

CERN | CLIC | DETECTOR R&D